Final Report of the "e-SRM Committee" on the Optimal Delivery of Services to Customers for Standard Reference Materials

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Abstract:

The e-SRM committee was formed at the request of Technology Services (TS) to recommend ways to employ appropriate technologies to optimize the consistency, efficiency, and effectiveness with which NIST provides technical support to customers for Standard Reference Materials (SRMs). The committee included representatives from Technology Services as well as from most of the technical divisions that provide for the certification of SRMs. Input was invited from virtually every staff member involved in the production of SRMs via an e-mail survey and/or circulation of a draft report for comment. Having gathered and organized the most frequent customer inquiries, the committee identified eleven areas of technical opportunity to address the needs expressed in those inquiries. The overriding concern of the committee is to improve customer satisfaction by means of seamless access to desired information, assistance, or suggestion/complaint registration without having prior knowledge of NIST or its organizational structure.

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Key Words:

certified reference material, data interchange, document delivery, electronic infrastructure, knowledge base, needs assessment, quality system, traceability, web-based tools

Foreword

At a NIST Town Meeting in January of 2000, NIST Acting Director Karen Brown challenged the NIST staff to envision how NIST in the future could and should look, building on its core strengths in measurement, science, and technology and taking full advantage of the current technology environment. The area of measurement services was identified as a good place to start, since many felt that the future delivery of such services might benefit substantially from advances in information technology. To stimulate and provide a context for discussion, descriptions of eight calibration and measurement service projects pursuing internet-based advances in service delivery were presented in two NIST-wide meetings. Several focus groups were also convened to discuss these and other possibilities for taking advantage of internet-based information and data exchange, as well as instrument control. Subsequently, I asked the author and presenter of one of the presentations, Dr. John C. Travis, if he would be willing to lead a special group to examine specifically and systematically how the development and dissemination of NIST Standard Reference Materials could be optimized, from the customer's point of view, by taking advantage of present and future advances in electronic communication. This report represents the outcome of the committee's four months of work, and some of the opportunities identified herein have already inspired implementation steps within the Standard Reference Materials Program.

<signed>
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Final Report of the "e-SRM Committee" on the Optimal Delivery of Services to Customers for Standard Reference Materials

Executive Summary: The e-SRM committee was formed at the request of Technology Services (TS) to fulfill the following *scope*:

> To recommend ways to employ appropriate technologies to optimize the consistency, efficiency, and effectiveness with which NIST provides technical support to customers for Standard Reference Materials (SRMs).

The committee included representatives from Technology Services, as well as from most of the technical divisions that provide for the certification of SRMs. Input was invited from virtually every staff member involved in the production of SRMs via an e-mail survey and/or circulation of a draft report for comment. Having gathered and organized the most frequent customer inquiries, the committee identified eleven areas of technical opportunity to address the needs expressed in those inquiries. The topic areas amenable to delivery of electronic services to customers of the Standard Reference Materials (SRM) Program, known as "e-SRM services," are:

- **Explanation of Traceability Issues** – *Both general and specific information about establishing traceability of a customer's measurement or calibration using an SRM.*
- **Instructions for Use** – *Specific details about how to prepare and use an SRM.*
- **SRM (CRM/RM) Applicability** – *Guidance on whether or not a specific SRM is suitable to address a customer's need.*
- **SRM (CRM/RM) Availability Projection** – *Technical information regarding the steps remaining in the certification process.*
- **Quality System Policy and Documentation** – *Information and documentation on NIST policy needed by customers to fulfill their own quality system requirements.*
- **Document Delivery** – *Electronic delivery of original and/or replacement certificates, reports, application notes, materials safety data sheets, etc.*
- **Web-Based Tools** – *Online computational tools to replace or supplement recommended procedures for processing data and/or correcting data for the use of SRMs in differing environmental conditions.*
- **Needs Assessment** – *A forum by which NIST can become informed of the needs of present and potential customers, and can evaluate the relevance of existing reference materials before committing to renewal.*
- **NIST Electronic Infrastructure** – *An internal infrastructure for supporting technical databases and linking such databases as appropriate to SRM production and distribution tracking systems.*
- **Technical Data Interchange** – *The ability to interchange data electronically with other National Metrology Institutes and with NIST customers.*
- **Knowledge-Base Technology** – *A rational organization of customer inquiries and suggestions and of technical responses from NIST staff to promote the accumulation and distribution of knowledge about SRMs, needed materials, applications, techniques, etc.*

The overriding concern of the committee is to improve customer satisfaction by means of seamless access to desired information, assistance, or suggestion/complaint registration without the having prior knowledge of NIST or its organizational structure. The ability to purchase SRMs online would be an important asset, but is considered to lie outside of the scope of the present committee.

I.   Introduction

Two open "town meetings" on the general topic of the delivery of NIST Measurement Services via the Internet were held early in 2000 at NIST. The sessions featured short talks on projects in various stages of completion followed by an open discussion and a later panel discussion. In the aftermath of those meetings, a committee was formed to consider a subset of the full range of possibilities covered in the town meetings – namely, the delivery of e-Services to customers of the Standard Reference Materials (SRM) Program of the Technology Services (TS) operating unit. However, the intent of the restricted scope of this project is to provide a reasonable starting point and to encourage the development of similar and compatible systems for SRMs, Standard Reference Data, and Calibrations. Specifically, the e-SRM Committee (ESC) was charged with recommending ways to employ modern communications technologies to optimize the consistency, efficiency, and effectiveness with which NIST provides technical support to customers for SRMs.

Support to SRM customers comprises both technical and business components. The ESC has focused its efforts on identifying promising opportunities to deliver SRM technical support. These opportunities are identified in this document. While focusing on the aspects of customer service delivery related to technical information, the ESC recognizes that these issues cannot be completely divorced from the considerations of good e-Business support. In parallel with the work of this committee, TS has invited proposals by a number of commercial suppliers of e-Business systems that incorporate extensive software and consultation for helping organizations handle customer interactions. Customers who contact NIST have a variety of questions of both a sales and technical nature. The ESC recognizes that efforts to implement technical opportunities should be coordinated with whatever e-Business systems are implemented by TS so that the customer has a single but comprehensive entry point to NIST services. Customers should not have to know arcane facts about the NIST organizational structure or particular SRM numbers in order to access information. They should be able to approach our web site or customer service representatives with simple requests based on their applications, measurement methodology, or instrumentation and be directed to satisfying answers or an appropriate alternative source.

This report presents candidate technical opportunities identified by the ESC. These measures vary widely in nature, including some that are inter-dependent and/or redundant. The list of these topics is not intended to imply a priority order.

II. Response to Customer Inquiries

To better define the present state of response to the top customer inquiries, the committee polled SRM coordinators and technical project leaders about the most common types of communications with SRM customers. The raw data were categorized and duplicates removed. The resulting categories are identified by the headings under Technical Opportunities below.

Questions under these categories range from those for which simple answers are accessible by an appropriate menu sequence to those that require attention by the appropriate coordinator or technical project leader. However, customer-inquiry categories are usually amenable to a simple "decision tree" approach, even if a particular branch ends only with the name and contact information for the appropriate NIST employee who should be consulted. A bare-bones implementation of a decision tree to address questions under these various categories could be achieved in short order, but the details and fullest implementation would evolve over time. The development of various "branches" would vary widely with the inclinations and time commitment of particular coordinators and technical project leaders.

A web-based customer-inquiry decision tree would start from the general and work to the specific. The NIST home page should have an obvious pointer to the TS page for people seeking reference materials, calibrations, or reference data. The link should point to a Technology Services page to give the customer an idea of which program is relevant to their particular need. The next page down would describe both our SRMs and Calibration Services, so that the customer would understand the distinction and choose the most appropriate for their application. The next page for SRMs would have an overview of the different types with guidance on their particular applications. After this, there would be pages specific to each SRM.

The decision tree from the NIST and TS home page to the existing on-line SRM catalog is a logical starting point for this implementation. SRM coordinators and corresponding technical project leaders should collaborate on appropriate linkages between the SRM catalog and supporting material on the laboratory web sites, and on generating such supporting material where none exists.

III. Technical Opportunities

The following sections outline technical opportunities that can be applied across a broad range of SRMs. In some cases a unified approach for all SRMs is desirable and in others implementation strategies specific to a particular SRM or SRM class are more appropriate. Although most of these categories are directly related to customer inquiries, a few will be recognized as being indirectly related through infrastructural considerations.

a. Explanation of Traceability Issues
It is essential that the NIST policy on traceability at

http://www.nist.gov/traceability/

be aggressively maintained for our customers. The committee formulating the NIST policy on traceability has provided such materials as FAQs (frequently asked questions) and examples as "Supplemental Materials" to the policy. Technical project leaders may wish to address traceability issues relevant to given SRMs or classes of SRMs on their own web sites, but these discussions should be consistent with the policy and provide appropriate links to the central traceability site.

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b. Instructions for Use

Many SRMs already have detailed instructions for use in appropriate Special Publication SP260 series documents. Any such documents should be identified for the SRM(s) in question, and the customer should be given instructions to obtain one by mail or download. Many of the older documents are not now available in electronic form, but could be made available online as scanned images and should probably be updated and re-issued. In addition, technical project leaders could generate application notes and FAQ pages on the use of particular SRMs.

c. SRM (CRM/RM) Applicability

Questions concerning the applicability of a given SRM to a specific need, or the identification of the proper SRM for a specific need, should be referred to the appropriate expert(s). In time, the experts may note recurring requests that merit the construction of an on-line answer, or one that may be read aloud from a computer monitor by a TS customer service representative.

d. SRM (CRM/RM) Availability

Certain issues concerning material availability are technical and within the scope of this committee. Questions that may seem administrative are linked to the technical staff through the scheduling of the certification process, etc. Some questions about existing SRMs could be (or can continue to be) addressed by the on-line SRM catalog on the web. Such questions should include whether an item is in stock (maybe also the number of units and average sales rate), projected re-stocking date, and expiration information. As the catalog evolves, it would be appropriate to include the contact information (e-mail, phone, fax) for the SRM coordinator and the laboratory technical project leader, as well as to web pages supported by the latter regarding the particular SRM or family of SRMs. However, consistency between the technical web page(s) and the catalog is paramount.

Questions related to materials not carried by SRMP could be handled by a simple electronic suggestion box, or might require human intervention at the outset. Such contacts include recommendations for new SRMs, possibilities for outside sources or alternative tests, etc. These interactions would necessarily occur at a level of the decision tree that represents categories of SRMs, and the customer could be directed to the contact information and/or web site for the SRM coordinator responsible for the category. In the short term, the SRM coordinator would be responsible for referring the customer to the proper NIST technical contact, as appropriate.

The issue of suggesting other suppliers needs a NIST policy statement for guidance. When a customer needs a standard material that we do not have (either because we have never produced it, or because we have discontinued it, or because it is out of stock), it would often provide a distinct service to the customer to be able to suggest alternate sources to them.

These measures can be readily implemented since much of the structure already exists on the TS/SRMP sites; customer gets immediate access to either an answer or a point of

contact with NIST. Care needs to be taken so that "canned" answers are not oversimplified or misleading.

e. Quality System Policy and Documentation
In response to the modern paradigm of quality systems, NIST customers are increasingly requesting quality system documentation from NIST relevant to SRMs that they purchase and employ for their own quality implementation. These customers should certainly be able to locate and print the institutional quality policy presently only available on the internal NIST web site at

http://www-i.nist.gov/director/quality_assurance.htm

as well as quality policy documentation from the group most directly responsible for the certification of the relevant SRM, which may be the relevant Special Publication.

f. Document Delivery
Customers often require replacements for certificates, material safety data sheets (MSDS), or SP260 documents that accompanied their SRMs but have been lost. Many such documents could be delivered in electronic form, with appropriate security measures (e.g., digital signatures) to assure that the document as displayed or printed is genuine, and has not been modified or tampered with.

An interesting variation on this theme is a certificate tailored to environmental and/or instrumental conditions specified by the customer. Such a customized "e-certificate" is discussed in the next section.

Another variation concerns SRMs that are individually certified, as in the case of some of the molecular absorption spectrometry standards (e.g., SRM 930e). To deliver web-based certificates for such materials, the database containing the certified values would need to incorporate appropriate security restrictions and customer identification coding to ensure that customers are matched to their specific data.

The advantages of implementing electronic document delivery are immediate customer fulfillment and reduction of handling costs. Care is needed to assure that the correct certificate is requested and delivered (e.g., renewal SRMs may have slightly different assigned values than prior series).

g. Web-Based Tools
Many SRM certificates give equations and coefficients to be applied to correct for differences in temperature, pressure, instrument bandwidth, etc. between the certifying environment and the measurement environment. The appropriate web site could provide several variants of tools, including downloadable executable programs, on-line calculators, and e-certificates. In the latter case, the customer specifies measurement conditions and their uncertainties, and the certified values are corrected in background to match the customer conditions. An example of web interactivity with the SRM program may be found at

http://www.nist.gov/widps-co2 .

Similarly, sometimes algorithms are associated with data extraction. Such is the case for NIST molecular absorption wavelength standards, for which peak positions must be extracted from spectral scans. The algorithm used by NIST could be made available to customers, so that algorithm-dependent bias would be minimized. In the short run, Statistical Tests can be addressed by referring customers to the NIST/SEMATECH "Engineering Statistics Handbook" found at

http://www.itl.nist.gov/div898/handbook/index2.htm

and to the "Links to other statistical software packages" on the ".../how to" page. More statistical help might be generated over time. Links to guidance on the issues related to uncertainty in measurement found at

http://physics.nist.gov/cuu/Uncertainty/index.html

would also be useful.

The committee is reluctant to endorse the concept of "black box" statistical decision-making tools in general, because this could potentially expose NIST to liability from the consequences of their misapplication. In the long run, it may be appropriate for technical coordinators to develop some statistical evaluation tools with appropriate oversight and approval before posting.

The use of web-based tools can lead to a reduction of mathematical errors in applying NIST-recommended algorithms. However, the potential for misapplication will always exist, and could expose NIST to liability actions.

h. Needs Assessment
Electronic capability should be employed to harvest information as well as to disseminate it. A customer forum or bulletin board would provide an opportunity for customers to share experiences and ideas with each other as well as with NIST support staff. Indeed, customers may wish to register direct requests for new SRMs or additional certified values for existing ones. Furthermore, data ranging from "hits" on particular sites to customer-furnished data can provide indirect evidence for needed evolution of the SRM product offerings.

Customers may be invited to register to receive automatic updates via e-mail on SRM product areas of interest. The registration form would permit voluntary information entry concerning their company and/or industry, application(s) for which SRMs are used, instrument and/or methods used, etc.

Customer requests and supporting data, industry roadmaps and surveys, as well as other needs-assessment white papers should be shared at NIST among all operating units on the

internal web site. Such resources would have to be properly indexed to facilitate effective archiving and data-mining of the information.

Improved needs assessment measures can lead to more timely SRM development for new technologies and improved match-to-mission. If customer input is not truly representative of industry needs, irrelevant SRMs might be developed.

i. **NIST Electronic Infrastructure**
The structure and culture of our organization differs greatly from a business that is focused on customer satisfaction as the sole indicator of success. This situation is the cause of many of our customer service shortcomings in the timely production, certification, and support of SRMs. Though it is beyond the purview of this committee to consider such structural issues, we see electronic connectivity as a way to improve communication across internal "cultural" boundaries and to enable NIST employees on the administrative and technical sides of SRMP to serve our customers with greater effectiveness and consistency.

A central electronic tracking system, the "Information System to Support Calibrations" (ISSC), has been implemented for the NIST Calibration program, and it is clear that the SRM program would benefit from such an approach as well. Such a system would act as the central clearinghouse for SRM inventory, order logging and filling, shipping, production, certification, re-certification, and customer service (handling of inquiries). The system would track stock levels, purchase rates, expiration data, and renewal milestones. The technical divisions would be asked to provide and regularly update production/certification milestones to help anticipate stock depletion rates and predict re-stocking times with reasonable accuracy. Parts of this tracking system could be actively linked to the public web site, so that outside customers would have the most up-to-date projections of stock conditions, etc.

A tracking system would integrate the disparate and unconnected databases maintained separately by SRMP and the technical divisions. When responding to customer inquiries, SRM coordinator and/or technical coordinators should be able to "call up" the customer file from the system, rapidly scan the customer contact history, SRM ownership, etc., and enter comments into the customer file. Customer contacts via e-mail should be archived by the system, with the ability to retrieve the information later by word search as well as by customer name.

Much of this capability *may* be realized through the envisioned e-Business system to be acquired by TS. In the meantime, a pilot program has begun to link data kept by SRMP to that maintained by the Optical Filters Program of the Analytical Chemistry Division (ACD). The participants propose to install software on an ACD computer to access the SRMP database used for tracking the optical filters SRMs supported by ACD. The database will need to be expanded appropriately to accommodate early-stage tracking information from ACD that has previously not been available directly to SRMP. ACD staff members will enter information on the acquisition of component materials, the number of filters of each type in the production pipeline, and projected completion dates

for small batches of filters. ACD will be able to directly monitor stock depletion, and SRMP will be able to directly monitor production/certification progress.

j. Technical Data Interchange

NIST utilizes comparison measurements with other National Metrology Institutes (NMIs) as a prime element of quality assurance and in the process of fulfilling various international agreements and committee responsibilities. "Round robin" studies are often conducted in the development of SRMs, with private industry and academia participating in addition to government laboratories. Proficiency testing via measurement comparisons with NIST is becoming a part of programs to leverage NIST measurement capabilities to the commercial sector via National Voluntary Laboratory Accreditation Program (NVLAP) accreditation and NIST Traceable Reference Material (NTRM) programs. All of these exercises would benefit from a variant of a web tool that is more advanced than the single-user tools discussed above under "Web-Based Tools."

This concept would permit various participants in measurement comparisons, round robins, or proficiency tests to post data to a central NIST-resident site, which would archive the comparative data and provide display as appropriate. Various conditions could be set for access to the data and for participant anonymity (or coded identification), if desired.

When designing the implementation of such features, adopting widely accepted data interchange standards that use tools like XML will be essential. NIST Information Technology Laboratory (ITL) expertise on streaming media and data visualization methods will also be a valuable asset.

Potential Benefits: Faster turn-around; higher frequency of comparison.

Possible Drawbacks: Development time and effort for data interchange standards.

k. Knowledge-Base Technology

Many support web sites incorporate an interface to indexed information and answers to commonly asked questions. This searchable knowledge base could well be applied to the support of NIST SRMs. Direct customer access would afford an all-hours resource for technical information. The knowledge base could also serve as a resource for SRMP customer service representatives during normal business hours. Content for this facility would come from SRM reports and publications normally produced by the technical divisions in the course of the certification process. Additional content could be generated in response to priority issues that arise from frequent customer inquiries. The knowledge-base system would incorporate automatic inquiry classification and counting to update and refine FAQs. Such statistics could also assist in planning for new SRMs. In fact, there could be a significant overlap of the software with that described in the Needs Assessment (above). The implementation of this technology should also be coordinated with ITL.

Knowledge-Base technology can be an efficient means to answer the easy, frequently asked support questions, thereby relieving some manpower requirements. At that same

time, total reliance on automated Q and A systems can lead to overly simplified answers to questions that have subtle complications.

IV. Implementation

One or more of the technical opportunities identified above could be implemented for individual or entire classes of SRMs. The implementation phase should include a discernment of the best matches between specific SRMs and list of opportunities. Prioritization criteria for such a list might include immediacy of impact, magnitude of impact (number of SRMs affected, number of customers impacted, consequences of impact), ease of implementation, etc.

Other generic issues will have to be addressed in the implementation phase. For a given SRM or class of SRMs, specific customer profiles will have to be identified and their technical needs assessed. Other implementation issues include:

- Accessibility of electronic information, including file format and compliance with the Rehabilitation Act and Section 508 using the guidelines developed by the Web Accessibility Initiative of the World Wide Web Consortium.
- Computer security
- Technical review of content (WERB/BERB)